Reasons Why 911 Sometimes Cannot Find Cell Phones

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Online at: https://findmesar.com/p/pdf/reasons_why_911_cannot_find_cell_phones.pdf

TL;DR If you call 911 with a cell phone be ready to give the dispatcher your latitude longitude coordinates in decimal degrees and the related accuracy value to help first responders reach you as quickly as possible.

Hopefully you will never need to call 911. But if that need arises, then these tips will help first responders find you as quickly as possible. Please feel welcome to share this potentially life-saving information however you wish.

I am a software developer in the field of online maps and location technology. A few years ago I did a deep dive into documents on the FCC website. I was looking for an answer to the following question. Do 911 call centers know your location when you call with a smartphone? This report shares what I learned.

Here is the answer. It depends on which 911 call center handles your call and what technology that call center is using. It might also depend on which wireless carrier handles your 911 call. Note that the carrier handling your 911 call can easily *not* be the carrier where you have your cell phone plan. Guess what? You do not know the answer to these variables.

There are well over 5,000 Public Safety Answer Points (PSAPs) in the USA. Many of them use add-on technology such as RapidSOS which increases the likelihood that the PSAP you called will get good coordinates for your location. But many other PSAPs rely only on e911 which is the basic location technology as defined by the FCC. These e911-only PSAPs might need your help to find you.

Here is the basic problem. PSAPs that are e911-only (i.e. no add-on technology to help find you) *do not* get the coordinates produced by your phone. Uber and many other services get the coordinates produced by your phone but e911-only PSAPs do not. Want to know the reason why?

Beginning with the iPhone 4s introduced in 2011 smartphones get location data from both the USA satellites (GPS) and Russian satellites (GLONNAS). The newest phones also get location data from additional satellite constellations. However, some people in congress thought that using Russian data for 911 was somehow a security risk. As a result, the FCC adopted a rule prohibiting data from any satellite constellation from being used for 911 unless first approved for that use by the FCC after a detailed hearing process. See for example this article from early 2015 https://sputniknews.com/us/201501291017526190.

The Russian GLONASS satellite constellation has never gone through that hearing process and therefore has never been approved by the FCC for use in 911. As a result, the standard e911 system uses data ==only from the USA satellites== to produce coordinates for your location.

Fewer satellites = Less data = Poorer accuracy   This is 911
More satellites = More data = Better accuracy   This is Uber

==Since 911 is prohibited by the FCC from using Russian data, Uber has more accurate locations for callers than 911.==

Here are a couple FCC documents noting that Russian data is not allowed for the purpose of 911.

1. See pages 14-15, paragraphs 39 and 40 of this 2015 FCC document.
https://apps.fcc.gov/edocs_public/attachmatch/FCC-15-9A1.pdf

2. See also footnote 47 at the bottom of p.9 of this March 2018 FCC document.
https://transition.fcc.gov/Daily_Releases/Daily_Business/2018/db0301/DOC-349523A1.pdf

When a smartphone is used to call 911 it is the responsibility of the wireless carrier to produce coordinates and an accuracy value for the caller. If a circle is drawn using the accuracy value as the radius, then there is supposed to be a good chance that the caller is inside that circle. Obviously smaller accuracy values are better than larger ones.

==Terminology==
==Phase 1== coordinates are the location of the cell tower carrying your 911 call. The 911 dispatcher always gets phase 1 coordinates. Of course you might be several miles away from that cell tower.
==Phase 2== coordinates. These are the coordinates the wireless carrier is supposed to produce for you location. This data goes into a database where it can be accessed by the 911 dispatcher.

Wireless carriers use two different methods to determine phase 2 coordinates and the accuracy value.

==Location method #1 for producing phase 2 coordinates.==

This method is used by the large wireless carriers and some of the smaller ones. Remember, e911 is barred by the FCC from using any data from the Russian GLONASS satellites. Therefore the wireless carrier handling your 911 call cannot simply grab the coordinates produced by your phone. Instead, this method whereby wireless carriers produce phase 2 coordinates for a cell phone caller works as follows.
1.   The phone sends the raw data from ==only the USA satellites== to the cell tower.
2.   Equipment on the cell tower processes that raw data and produces phase 2 coordinates and an accuracy value.
3.   The coordinates and accuracy value go into a database as already described.

However, by relying on data from only the USA satellites the wireless carrier might (1) never put any phase 2 coordinates into the database or (2) put coordinates into the database that have very poor accuracy. **Below are some reasons for why these problems arise.**

Years ago I routinely used a Magellan GPS on trips in the Washington State Cascades. That unit only received data from USA satellites. I learned that unless my Magellan had a clear view of the sky that it might not produce any coordinates. This is because any device has to receive data from at least 3 satellites in order to determine coordinates. Line-of-sight to satellites can be obstructed by heavy forest, mountains, canyon walls, buildings, etc.

A second problem relates to the shape of the satellite constellation that a phone or GPS unit can 'see' at any given time. And remember, for e911 we are talking about **only the USA satellites**. The closer to a straight line the shape of that constellation becomes, the worse the accuracy becomes for any coordinates that are produced.

Wireless carriers that try to produce phase 2 coordinates using data only from USA satellites will have the exact same problems that I experienced with my Magellan GPS.

My first cell phone was an iPhone 4s (USA and Russian satellites). I tested that phone's ability to produce coordinates with a good accuracy value on various trips in the Cascade Mountains. I watched for locations where my Magellan GPS (USA satellites only) did not work very well due to a poor view of the sky resulting from heavy forest and/or mountains. There was only one time in an old growth forest when my iPhone 4s failed to produce coordinates with a decent accuracy value and that was easily fixed by moving a few feet along the trail.

In short, the location problems caused by only using data from USA satellites largely go away when using data from both USA and Russian satellites.

Location method #2 for producing phase 2 coordinates

This method is used by a lot of smaller wireless carriers and is based on several different technologies that are related to cell tower triangulation. This is generally considered less accurate than location method #1 already described. For example, if the towers that a phone can see are more-or-less in a line (as in along a highway) then triangulation is not going to work very well.

Next, I am going to tell you about exemptions.

The FCC allows wireless carriers to exempt themselves from producing *any* phase 2 coordinates for large areas. All the carrier has to do is file a piece of paper with the FCC. Carriers that use location method #1 simply have to state that an area is heavily wooded. Carriers that use location method #2 simply state that they lack sufficient cell tower density. Many of these exemptions apply to entire counties. The FCC does not make any meaningful review of these self-claimed exemptions.

The Colorado 9-1-1 Resource Center keeps track of the phase 2 exemptions filed by the wireless carriers. Below is a link to their current data on this topic.
https://docs.google.com/spreadsheets/d/1HbBgD2KKx_umIOEYZx0UgBMu3Vg0t7nztBTI5jpJJuM/edit#gid=0

What about recent versions of iOS and Android that have emergency features to help contact 911? Those solutions do not work with PSAPs that are using standard e911 technology. Instead, those solutions that are now part of iOS and Android only work if your 911 call is handled by a PSAP that is using more advanced technology.

By now I hope I have convinced you to **not assume** that 911 magically knows your location when you call for help with a cell phone. Instead, each of us needs to be able to give 911 our coordinates and accuracy value. The coordinates should be given as latitude longitude in decimal degrees since that is the same format as the phase 2 coordinates provided by the wireless carriers. In other words, that is the coordinate format 911 dispatchers are used to seeing.

One way to get your coordinates - FindMeSAR

I do not care what software you use to get your coordinates. I do care that the software is super easy to use so you do not mess up in a stressful situation.   Here is one option to consider.

Several years ago I developed the FindMeSAR webpage (https://findmesar.com) so everyone could have an easy way to know their coordinates and the related accuracy value. This is a public service project and part of my way to "pay it forward". FindMeSAR is open source. Anyone that can read code can look at the source code via their browser and confirm there is no evil intent.

Note that FindMeSAR is a webpage (not a native app). It can display four different coordinate formats and each one has a different colored background. The "Next format" button scrolls through the four formats.

Yellow	Latitude longitude, decimal degrees (same format as phase 2 coordinates)
Red	Latitude longitude, degrees and decimal minutes
Blue	U.S. National Grid (USNG). Same as MGRS.
Green	UTM

FindMeSAR includes an icon you can save on your homescreen and a "Tips" button with more information. If you ever need to give 911 your location, the **yellow screen** shows the coordinate format (latitude longitude in decimal degrees) and accuracy value that you should give to the 911 dispatcher.

The first time a person opens FindMeSAR on their phone the code is saved in a special part of the browser's memory. This webpage will then open and work offline. (This is done with service worker technology plus AppCache as a fallback.) This would be useful for someone that only has such a weak cell connection that they can text for help but cannot make a voice call. They could get their coordinates and accuracy value from FindMeSAR and paste that data into a

text. Of course this assumes the person previously opened FindMeSAR when they were online so that the code gets saved on their phone.

I hope you never need to call 911 in an emergency. But if you do, please have some way to give the dispatcher your coordinates (latitude longitude in decimal degrees) and accuracy value.

Additional resources - PDF reports
==You are reading==> https://findmesar.com/p/pdf/reasons_why_911_cannot_find_cell_phones.pdf
https://findmesar.com/p/pdf/smart_way_call_911_with_cell_phone.pdf
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Additional resources - Web Apps
FindMeSAR - https://findmesar.com
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